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Indian Standard

METHODS OF
SAMPLING STEEL WIRES

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Indian Standard

METHODS OF SAMPLING STEEL WIRES

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SHRI T. R. PURI

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Indian Standard

METHODS OF SAMPLING STEEL WIRES

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 25 June 1982, after the draft finalized by the Methods of Sampling Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 Steel wires have been found to be highly versatile and are used in variety of ways, for example, for general engineering purposes, telegraph and telephone purposes, in machine screws, wood screws, springs, umbrella ribs, spokes, ropes and rivets. In the context of this ever increasing production of steel wires, it is imperative that due consideration is given to the sampling procedures which will help in the proper and objective evaluation of the visual, dimensional, physical and chemical properties of this product.

0.3 Proper quality control during the process of manufacture would substantially reduce the quality fluctuations of the ultimate product. For effective process control, the use of statistical quality control techniques is imperative, for which helpful guidance may be obtained from IS : 397 (Part I)-1972* and IS : 397 (Part II)-1975†. A recommended frequency of testing and inspection is, however, given in Appendix A to serve as a guide to the manufacturers.

0.4 This standard contains clauses 4.2.1 and 4.4.1 which call for agreement between the purchaser and the supplier.

0.5 In reporting the results of a test or analysis, if the final value observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960‡.

1. SCOPE

1.1 This standard prescribes the methods of sampling and criteria for conformity for steel wires.

*Methods for statistical quality control during production: Part I Control charts for variables (*first revision*).

†Methods for statistical quality control during production: Part II Control charts for attributes and count of defects (*first revision*).

‡Rules for rounding off numerical values (*revised*).

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Coil — One continuous length of wire as drawn in the form of a coil.

2.2 Item — A unit such as coil meant for inspection or testing.

2.3 Lot — The total number of items of same grade and dimensions manufactured under essentially similar conditions of manufacture.

2.4 Lot Size — Number of items in a lot.

2.5 Sample — Collection of items selected for inspection or testing from a lot.

2.6 Sample Size — Number of items in a sample.

2.7 Defect — Failure to meet the requirement imposed on an item with respect to a single characteristic.

2.8 Defective — An item having one or more defects.

2.9 Acceptance Number (a) — The maximum permissible number of defectives in the sample(s) for acceptance of the lot.

2.10 Acceptable Quality Level (AQL) — The maximum percent defective that, for the purpose of sampling of steel wires, can be considered satisfactory as a process average.

NOTE — When a purchaser designates some specific value of AQL, he indicates to the supplier that his (purchaser's) acceptance sampling plan will accept great majority of the lots that the supplier submits, provided that the process average level of percent defective in these lots is not greater than the designated value of AQL. Thus, AQL is a designated value of percent defective that the purchaser indicates which will be accepted most of the times (approximately 89 or 99 percent).

3. PROCESS CONTROL

3.1 The object of inspection and testing steel wires by the purchaser is to ensure their conformity to the specification requirements, whereas the inspection done by the manufacturer during production is to ensure conformity to relevant specification as also to maintain better control over the process. Quality control during production can build the quality and reliability in steel wires whereas inspection done later on can only sort out the good products from the bad ones. Because of the economy that would result from the former approach, it is recommended that the manufacturer should take representative sample of material and test at

regular intervals to control the quality fluctuations during production. The inspection levels given in Appendix A may serve as a guide for routine control over the manufacturing process.

4. LOT INSPECTION

4.1 In case adequate and satisfactory system of quality control has been maintained, the resulting data and information may be made available to the purchaser, along with items supplied to enable him to judge the acceptability of the lot. When it is not possible to make such information available to the purchaser or if the purchaser so desires, the procedure laid down in the following clauses shall be followed for determining the conformity of the steel wires to the requirements of the relevant specifications.

4.2 The sample shall be selected and examined for each lot separately for ascertaining their conformity to the requirements of the relevant specifications.

4.2.1 Unless otherwise agreed to between the supplier and the purchaser, each and every coil shall be visually examined for freedom from defects and defective ones removed.

4.3 The lot which is free from surface defects shall be inspected for dimensional requirements. The number of items to be selected from a lot for this purpose depends upon the size of lot and shall be in accordance with col 1 and 2 of Table 1.

4.3.1 The items shall be selected from the lot at random. For selecting the items at random the provisions contained in IS : 4905-1968* shall be followed.

4.4 Each of the items selected according to 4.3 shall be inspected for dimensional requirements. Any item failing to meet the dimensional requirements shall be termed as defective. The lot shall be considered as conforming to the dimensional requirements, if the number of defectives found in the sample is less than or equal to the corresponding acceptance number given in col 3 of Table 1; otherwise the lot shall be rejected.

4.4.1 In case of those lots which have not been found satisfactory, all the items in the lot may be inspected for dimensional requirements and the defectives be removed, if agreed to between the purchaser and the supplier.

*Methods for random sampling.

**TABLE 1 SCALE OF SAMPLING AND ACCEPTANCE NUMBER
FOR DIMENSIONAL AND PHYSICAL CHARACTERISTICS**

(Clauses 4.3, 4.4, 5.2 and 5.4)

LOT SIZE (No. of COILS)	DIMENSIONAL REQUIREMENTS		PHYSICAL CHARACTERISTICS	
	Sample Size	Acceptance Number	Sample Size	Acceptance Number
(1)	(2)	(3)	(4)	(5)
Up to 25	8	0	2	0
26 „ 50	13	1	3	0
51 „ 150	20	1	5	0
151 „ 300	32	2	8	0
301 and above	50	3	13	1

NOTE — The associated AQL (see 2.10) for dimensional and physical characteristics is 2.5 percent. This AQL values will strictly hold good only in the case of larger lots.

5. PHYSICAL CHARACTERISTICS

5.1 The lot which has been found satisfactory for visual and dimensional requirements shall next be tested for physical characteristics like tensile test, bend test, wrapping test, adhesion test, coating test and resistance test.

5.2 The number of items to be selected at random for this purpose shall be in accordance with col 1 and 4 of Table 1.

5.3 From each of the items so selected, the required number of test specimens of adequate length shall be prepared and subjected to the physical tests specified.

5.4 If an item fails to meet the requirement for any of the physical tests specified, it shall be termed as defective. The lot shall be considered as conforming to the requirements of physical characteristics, if the number of defectives found in the sample is less than or equal to the acceptance number given in col 5 of Table 1, otherwise the lot shall be rejected.

6. CHEMICAL CHARACTERISTICS

6.1 The lot which has been found satisfactory with respect to visual and dimensional requirements shall be tested for chemical analysis. The test certificate for the basic steel issued by its manufacturer shall be provided

in respect of each heat/cast and the lot shall be considered to have conformed to chemical requirements on the basis of basic steel manufacturer's chemical analysis certificates. However, in the absence of these certificates and also in the case of dispute between the purchaser and the supplier, the lot shall be tested in the following manner. The number of coils required for this purpose shall be taken at random in accordance with col 1 and 2 of Table 2. These may be taken from those coils which have been found conforming to dimensional and physical requirements.

TABLE 2 SCALE OF SAMPLING FOR CHEMICAL ANALYSIS

NUMBER OF COILS IN A LOT	NUMBER OF COILS TO BE SELECTED
(1)	(2)
Up to 25	2
26 to 100	3
101 to 300	5
301 and above	8

6.2 From each of the coils so selected a test piece of required length shall be cut and tested for chemical analysis.

6.3 When two samples are analysed for chemical analysis from a lot, the lot shall be considered as conforming to the requirements of the specification if both the samples pass and shall be rejected, if both samples fail. If one sample fails, two more samples shall be taken and tested for the characteristics in which it has failed. The lot shall be considered as conforming to the requirements if both the samples pass; otherwise the lot shall be rejected.

6.4 When three or more than three samples are analysed from a lot, calculate the mean (\bar{x}) and the range (R) from the test results, as given below:

$$\text{Average } (\bar{x}) = \frac{\text{Sum of the test results}}{\text{Number of test results}}$$

$$\text{Range } (R) = \text{Difference between the maximum and minimum values of test results.}$$

6.5 If the specification limit for the characteristic is given as a minimum value, the expression ($\bar{x} - kR$) shall be calculated from the relevant test results. If the value obtained is greater than or equal to the minimum specification limit, the lot shall be considered as conforming to the requirements of that characteristic.

6.6 If the specification limit for the characteristic is given as a maximum value, the expression $(\bar{x} + kR)$ shall be calculated from the relevant test results. If the value obtained is less than or equal to the maximum specification limit, the lot shall be considered as conforming to the requirements of that characteristic.

6.7 If the characteristic has two-sided specification limits, the expressions $(\bar{x} - kR)$ and $(\bar{x} + kR)$ shall be calculated from the relevant test results. If the values obtained lie between the two specification limits, the lot shall be declared as conforming to the requirements of that characteristic.

6.8 The value of the factor k referred to earlier shall be chosen in accordance with Table 3 depending upon the desired acceptable quality level.

TABLE 3 VALUES OF k FOR ACHIEVING DIFFERENT ACCEPTABLE QUALITY LEVEL

ACCEPTABLE QUALITY LEVEL (PERCENT)	VALUE OF k
(1)	(2)
2.5 and up to 4.0	0.4
1.0 up to and excluding 2.5	0.5
Less than 1.0	0.6

APPENDIX A

(Clauses 0.3 and 3.1)

RECOMMENDED LEVELS OF INSPECTION/TESTING

<i>Sl No.</i>	<i>Characteristics for Inspection/Testing</i>	<i>Frequency of Inspection/Testing</i>
i)	Chemical composition	A product analysis from every cast
ii)	Visual inspection for surface defects	Each coil
iii)	Dimensions and weight	Each coil
iv)	Tensile test	Every fifth coil
v)	Bend Test	do
vi)	Wrapping test	do
vii)	Coating test	do
viii)	Resistance test	do